Journal of Research on the Lepidoptera 12(3):127-134, 1973

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ON THE ORIGIN OF AUSTRAL ELEMENTS IN THE MOTH FAUNA OF SOUTH-EASTERN ONTARIO, INCLUDING A NUMBER OF SPECIES NEW FOR CANADA

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INTRODUCTION

Several authors have noticed the unique floral and faunal composition of a small area in south-eastern Ontario, consisting of Prince Edward County and the southern portions of Lennox and Addington, Frontenac and Leeds Counties (e.g. Hainault, 1968; Snyder *et al*, 1941; Soper, 1962). Typical austral elements in the ecosystem are much more numerous here than in any other area of Ontario, except the region bordering on Lake Erie.

In recent work concerning the faunal composition of this region we have found a unique abundance of species of Macroheterocera (Hebert, 1969; Harmsen, Hebert and Ward, 1974). Many hitherto considered rare species, some only collected from the Lake Erie region, appear to be relatively common, and a number of species were collected that were new for Canada.

In this communication, we want to record these species as well as two species new for Canada collected on Pelee Island in Lake Erie.

The origin of the austral elements in south-eastern Ontario is a much discussed problem. The composition of the Macroheterocera fauna adds some evidence.

COLLECTING METHODS AND SITES

The south-eastern Ontario records were all collected during a comprehensive complete-season collecting programme conducted at three sites: Glenburnie, Kingston Twp., Frontenac County (5 miles north of Kingston) from 26 April, 1969 to 30 April, 1970; Perth Road, Storrington Twp., Frontenac County

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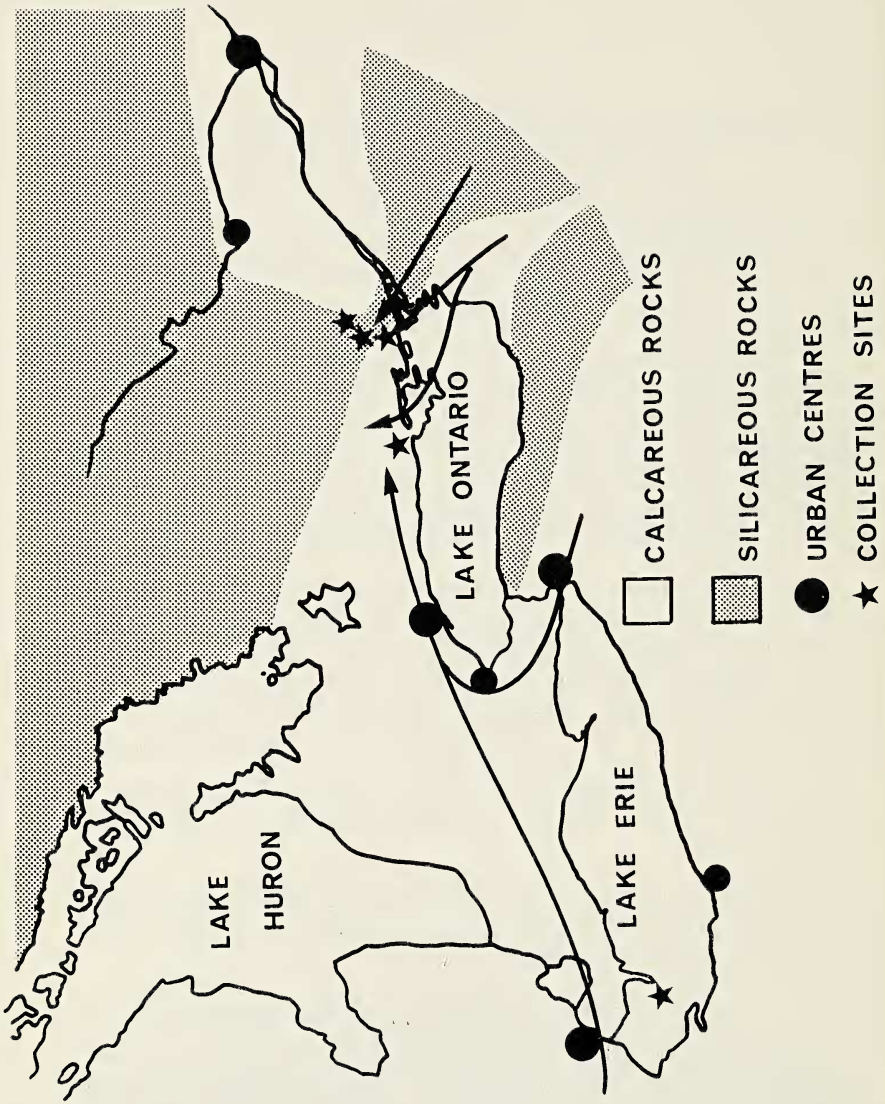

Fig. 1.—Southern Ontario and surrounding regions, showing main geological strata and possible invasion routes for austral elements in the flora and fauna of south-eastern Ontario.

(20 miles northeast of Kingston) from 4 May, 1970 to 26 August, 1970, and from 12 April, 1971 to 1 November, 1971; Queen's University Biological Station, Chaffey's Locks, South Crosby Twp., Leeds County (30 miles northeast of Kingston) from 30 May, 1967 to 7 September, 1967, from 1 May, 1969 to 14 September, 1969, and from 1 May, 1970 to 30 October, 1970, (see Fig. 1). The first site is located in marginal agricultural land on Ordovician limestone. The other two locations are in areas of mixed forest on Precambrian metamorphic rock.

Moths were collected using a 20 watt ultraviolet light (GE F20T12BL) against a white cloth background. The light was run all night and the moths were collected off the sheet at dawn. These regular collections were supplemented by sporadic night collecting in Northumberland County, near Trenton, Ontario in May 1972.

The new species from Pelee Island, Essex County were both collected with an ultraviolet light on a single night's collecting: 6 August, 1969.

NEW CANADIAN RECORDS

We consider a species new for Canada, if it is unrecorded in the literature and if there are no Canadian records in the Canadian National Collection, Ottawa (CNC), the American Museum of Natural History, New York (AMNH), or the Royal Ontario Museum, Toronto (ROM).

1. *Crambidia pura* Barnes & McDunnough. Determined by J. C. E. Riotte.
   Glenburnie, 12-26 June, 1969 (5); 6-31 August, 1969 (18).

The American Museum of Natural History contains a series of specimens taken on Picton Island, Clayton, New York, less than two miles from the Canadian border and only about 15 miles from Glenburnie.

2. *Cleora sublunaria* Guenée. Determined by F. H. Rindge.
   Perth Road, 19 May, 1971 (1).

A single male of this species was taken on the above date. Its congener, *Cleora projecta* was also taken in May, 1971 at Perth Rd. *C. sublunaria* was not previously known north of latitude 41°N (northern New Jersey, New York City, central Illinois), (Rindge, 1972).

3. *Mellila xanthometata* Walker. Determined by W. C. McGuffin.
   Pelee Island, 6 August, 1969 (2).

Although this species is known from the north-eastern states (specimens in CNC, AMNH), the above specimens apparently represent the first Canadian records.

4. *Orthosia alurina* Smith.
   Chaffey's Locks, 1 May, 1970 (1).

A single male, whose identity was confirmed by genitalic examination, was collected on the above date. This species is known from New York (Forbes, 1954) and southern Michigan (Nielsen, pers. commun.).

5. *Lacinipolia implicata* McDunnough. Determined by J. G. Franclemont.

   Chaffey's Locks, 17 August-7 Sept., 1967 (9); 25 August-1 Sept. 1969 (5); 20 August-7 Sept. 1970 (18); Perth Road, 9-26 August, 1970 (204); 13 August-20 Sept. 1971 (253).

In the CNC there are specimens of *L. implicata* from New Jersey, North Carolina, Tennessee, and Arkansas. It has also been recorded from New York (Forbes, 1954) and Michigan (Moore, 1955). It was found to be surprisingly abundant at the Perth Road locality.

6. *Lithophane querquera* Grote.
   Perth Road, 11 May, 1971 (1).

Identification was confirmed by examination of male genitalia. This species is known from the north-eastern states (Forbes, 1954) but not from Michigan (Nielsen, pers. commun.).

7. *Eutolype electilis* Morrison. Determined by J. G. Franclemont.
   Frankford, Northumberland Co. 15 May, 1972 (1). Chaffey's 1-6 May, 1969 (2); 1-10 May ,1970 (3); Glenburnie, 19 May, 1971 (10).

The single specimen from Frankford is typical *electilis;* the remainder are all form *depilis* Grote. This species is known from Ithaca, New York (Leonard, 1928), Pennsylvania (in CNC), and southern Michigan (Moore, 1955).

8. *Oligia chlorostigma* Harvey. Determined by J. G. Franclemont.
   Perth Road, 23 July, 1971, (1).

Generally considered a rare species, *O. chlorostigma* is known from New York (Forbes, 1954) and southern Michigan (Moore, 1955).

9. *Neperigea costa* Barnes and Benjamin. Determined by J. G. Franclemont.

   Chaffey's Locks, 28 June, 1972 (1); Perth Road, 9-26 July, 1970 (3); 27 June-2 August, 1971 (10).

This species, which is not mentioned by Forbes (1954) or Moore (1955), is primarily a denizen of the American south-west, although it was recently reported from New Jersey (Franclemont, pers. commun.). The above records obviously represent a remarkably disjunct population. In the CNC there is a single specimen of *costa* bearing two labels as follows: "29.VI.18/Gull Lake/Muskoka, Ont." and "Doubt/label/McD." In the light of these recent captures it appears that this old specimen may not have been mislabelled, as was previously supposed.

10. *Bellura melanopyga* Grote. Determined by D. F. Hardwick.
    Pelee Island, 6 August, 1969 (1).

The only specimens of *B. melanopyga* in the CNC are from Florida; however, Franclemont (pers. commun.) reports it from farther north including Maine and New York.

11. *Zale phaeocapna* Franclemont. Determined by J. G. Franclemont.
    Chaffey's Locks, 1-23 May, 1969 (14); 1-31 May, 1970 (17); Perth Road, 8-30 May, 1970 (5); 7 May-7 June, 1971 (37).

This species is closely similar to *Z. galbanata.* The latter species has also been collected by the present authors, at Glenburnie and at Chaffey's Locks, where it tends to fly somewhat later than *Z. phaeocapna.*

A note of interest is that the Perth Road collecting site is far removed from any hard pine but surrounded by abundant white pine. Thus *phaeocapna* may not be restricted to feeding on hard pines as indicated by Franclemont (pers. commun.). The apparent discontinuous distribution between the present collection and the known range of *phaeocapna* (Forbes, 1954) and the different host plant dependence may suggest that the present collection represents a species close to, but not continuous with *phaeocapna.*

LOCATION OF SPECIMENS

Specimens of the present collections were deposited in the following locations:

Crambidia pura	—	CNC, AMNH, ROM, Queen's U.
Cleora sublunaria	—	CNC
Mellila xanthometata	—	CNC
Orthosia alurina	—	CNC
Lacinipolia implicata	—	CNC, Queen's U.
Lithophane querquera	—	CNC
Eutolype electilis	—	CNC, Queen's U.
Oligia chlorostigma	—	CNC
Neperigea costa	—	CNC, Queen's U.
Bellura melanopyga	—	CNC
Zale phaeocapna	—	CNC, AMNH, Queen's U.

FAUNAL SIGNIFICANCE OF AUSTRAL ELEMENTS

Four distinct theories are at hand which by themselves or together could explain the unique faunal elements recently observed in south-eastern Ontario.

Firstly, recent drastic changes in the biosphere as a result of human interference in the ecosystem may have considerable effect on faunal integrity and composition. Much of the natural climax forest has been replaced with man-made savannah, and, probably secondarily the climate of north-eastern North America appears to have undergone a warming trend in the past hundred years or so (Thomas, 1957). In these circumstances, not only may marginal species disappear, but new invader species may spread. The latter phenomenon may be expected especially in flying animal species such as moths.

Botanical evidence suggests that the austral elements of the south-eastern Ontario flora are a remnant of the previous climatic high (7-3000 years b.p.) rather than the result of recent invasions (Hainault, 1968). One could expect an associated defoliating animal population to include remnant austral elements as well. Some of the records presented above appear to represent recent colonization resulting from environmental disturbance. For instance *Crambidia pura* may be a recent invasion based on agricultural ecology. Such relatively western species as *Polia segregata* Smith, *Senta defecta* Grote, *Platyperigea meralis* Morrison and *Oncocnemis viriditincta* Smith which have recently been collected in south-eastern Ontario (Harmsen, Hebert and Ward, 1974), supply further evidence for this trend. *Zale phaeocapna* may have expanded its range recently, taking advantage of man's habit of planting red pine in many areas where the tree is not indigenous. There could, however, also be

a link between this species and local populations of red pine and pitch pine in south-eastern Ontario, but equally likely it could represent a remnant population, adapted to different host plants.

The ecological characteristics of other new species however, are not at all suggestive of recent colonization. For example, *Orthosia alurina, Lithophane querquera, Eutolype electilis* and *Lacinipolia implicata* are typically associated with deciduous forest habitats in south-eastern Ontario and can hardly be considered spreading northward as a result of a pre-adaptation to man-made aspects of the agricultural ecosystem.

The present records, therefore, seem to reveal, in at least some of the cases, the presence of the anticipated austral fauna, dependent on the typical austral flora of the same region. The origin of this austral refugium in south-eastern Ontario remains a point of debate.

Botanical evidence suggests an invasion of eastern Ontario from New York (see Fig. 1), in a northerly direction across the islands of the upper St. Lawrence River (following acid soils and Precambrian rock, into Ontario Shield country) and eastern Lake Ontario (following alkaline soils and Ordovician limestone via either Wolfe Island or the Jefferson Islands into Prince Edward County) dated at approximately 6000 years b.p.; followed by a general regression during the past 3000 years as a result of a cooling trend in the climate. An invasion in a north-easterly direction from the Lake Erie region along the north shore of Lake Ontario seems far less likely (Hainault, 1968). This latter invasion route, however, finds some support in the distribution of macroheterocera.

Lacinipolia implicata, Eutolype electilis, Orthosia alurina and *Oligia chlorostigma* are known from southern Michigan (Moore, 1955; Nielsen, pers. commun.) but not from northern New York State (Leonard, 1928; Forbes, 1954; Franclemont, pers. commun.). Similarly such components of the south-eastern Ontario fauna as *Phoberia atomaris* Hubner, *Chaetaglaea cerata* Smith, *Xylomiges alternans* Walker, *Stenoporpia polygrammaria* Packard, *Eupithecia rindgei* McDunnough, *Anisota finlaysoni* Riotte, *Cisthene unifascia* Grote & Robinson, *Poanes viator* Edwards, *Euphyes dion* Edwards, and *Callophrys gryneus* Hubner are western and/or southern species not known from northern New York.

Some of these species have distinct distributions, being apparently absent from the north shore of Lake Ontario between Toronto and Kingston. However this may be partly due to lack

of collecting or disturbance of the original vegetation. Some recent collections made in Northumberland County (approximately 80 miles south-west of Kingston) have disclosed a similar austral fauna (e.g. *Catopyrra coloraria* Fabricius, *Eutolype rolandi* Grote, *Eutolype electilis,* and *Phoberia atomaris*).

Some of these species are not associated with an austral flora. Shapiro (1970) presents biogeographical evidence to suggest that *Poanes viator, Euphyes dion,* and other marsh butterflies entered the Great Lakes area through the Mohawk Valley in New York at a time (approximately 10,000 b.p.) when the St. Lawrence was blocked by ice and the Ontario basin discharged via the Mohawk Valley to the Hudson and thence the Atlantic. At that time, however, the predominant forest was spruce and fir. Some macroheteroceran species with disjunct distribution patterns may have reached south-eastern Ontario in this fashion but it seems likely that the typical austral elements of the south-eastern Ontario fauna invaded the area much later, during the xerothermic period either northwards from northern New York, or north-westwards from the Lake Erie region.

Since the typical hardwood forest type of the Kingston region appears to cover both limestone formations and Shield country, we feel that the connection between subsoils and migration routes (Fig. 1) has perhaps been overstressed in the past. Certain specialized plants may well be strongly affected by soil types, but the main hardwood species serving as host plants to the majority of phytophagous insects are not.

The meterological zones of southern Ontario may provide a much more convincing clue to the present distribution of macroheterocera. The tempering effect of Lake Ontario on temperature distribution, humidity, precipitation, snow cover and other climatic factors is probably the main cause of the presence of an area to the north-east of the lake with climatic conditions similar to a narrow strip along the north shore of the lake and the region of the Niagara Peninsula (Phillips and McCulloch, 1972): the prevailing south-west winds in the entire region would easily allow biological dispersal in a north-easterly direction along the north shore of Lake Ontario. North-westerly dispersal from northern New York would be across the prevailing wind, and would have to cross an extensive area directly to the east of the lake endowed with very different climatic conditions (Phillips and McCulloch, 1972).

ACKNOWLEDGMENTS

The authors wish to thank the following persons for their assistance with the identification of a number of species: Dr. J. G. Franclemont, Cornell University; Dr. D. F. Hardwick, Entomology Research Institute, Ottawa; Dr. W. C. McGuffin, Entomology Research Institute, Ottawa; Dr. F. H. Rindge, American Museum of Natural History, New York; and Rev. J. C. E. Riotte, Royal Ontario Museum, Toronto. We are also grateful to Mr. M. Nielsen, for distributional information on Michigan Lepidoptera.

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